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Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11)

**EP 0 895 380 A2**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
03.02.1999 Bulletin 1999/05

(51) Int Cl.<sup>6</sup>: **H04L 12/56, H04Q 3/00,  
H04J 3/16**

(21) Application number: **98301856.5**

(22) Date of filing: **12.03.1998**

(84) Designated Contracting States:  
**AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC  
NL PT SE**  
Designated Extension States:  
**AL LT LV MK RO SI**

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(30) Priority: **31.07.1997 GB 9716198**

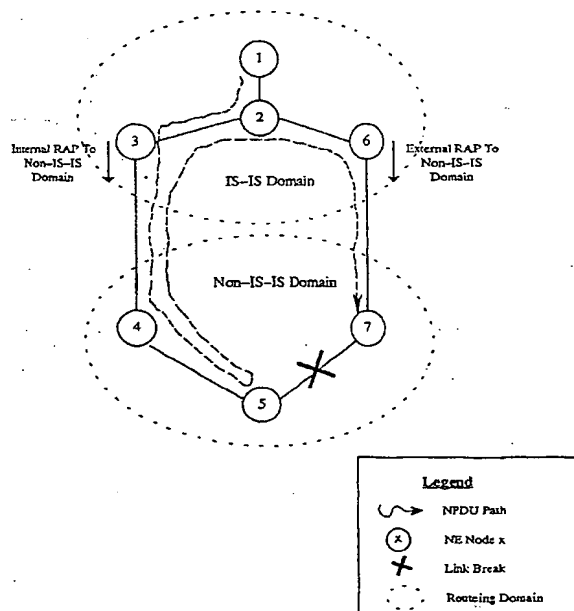
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(54) **Reachable Address Prefix alternative routing for iso 10589**

(57) In a Synchronous Digital Hierarchy (SDH) based communications network comprising a plurality of Intermediate Systems (IS), the IS being divided between at least one IS-IS Area and at least one non-IS-IS Area, an IS-IS Area being an area with which a routing protocol forming part of the Network Layer (Layer 3) of the Open Systems Interconnection including routing

(OSI), is provided for routing messages between areas, including routing means, whereby where a message is routed from an IS-IS Area to a destination IS within a non-IS-IS Area and the connection to the destination IS is broken, and as a result a message is returned from the non-IS-IS Area to the originating IS-IS Area connection to the destination IS is made by a second choice connection.

Figure 1.



EP 0 895 380 A2

## Description

[0001] Synchronous Digital Hierarchy (SDH) equipment is the latest generation of equipment that is used to provide high bandwidth communications capabilities for use between telephone exchanges and in other areas where high quality telecomms is required (broadcast video distribution, etc). Embedded within the traffic 'traffic' carrying capability of the equipment are data communications channels (DCCs). These channels constitute a datacomms network that uses OSI protocols.

[0002] Each piece of equipment constitutes a routing node in the datacomms network formed by the data channels, and can operate any one of a number of different routing methods. The present invention is concerned with the interworking of two of the possible routing method.

[0003] The two routing methods that will commonly occur in SDH networks are IS-IS (ISO 10589) and quasi-static routing (where alternate routes may be chosen on link failure). Where this occurs, routing loops, causing loss of communications can be caused. The present invention detects the formation of a routing loop and changes the behaviour of the IS-IS node accordingly.

[0004] The IS-IS routing protocol is one of a set of 'link state' dynamic routing protocols. These protocols automatically distribute routing information round the datacomms network, allowing nodes to learn the required routing information from the actual network. This provides the ability to automatically reconfigure, allowing routing round network faults, in case of network link failure.

[0005] The IS-IS routing protocol has two routing levels, Level-1 and Level-2. See Figure 2 (from ISO 10589) for the use of these levels and the general environment of this protocol and the topologies and systems supported by Intradomain Routing.

[0006] The present invention is also applicable to other datacomms scenarios, where a dynamic routing protocol is interworked with static routing, or a different dynamic protocol (e.g. OSPF and static routes, etc).

[0007] According to the present invention there is provided a Synchronous Digital Hierarchy (SDH) based communications network comprising a plurality of Intermediate Systems (IS), the ISs being divided between at least one IS-IS Area and at least one non-IS-IS Area, an IS-IS Area being an area with which a routing protocol forming part of the Network Layer (Layer 3) of the Open Systems Interconnection including routing (OIS), is provided for routing messages between areas, including routing means, whereby where a message is routed from an IS-IS Area to a destination IS within a non-IS-IS Area and the connection to the destination IS is broken, and as a result a message is returned from the non-IS-IS Area to the originating IS-IS Area connection to the destination IS is made by a second choice connection.

[0008] There is further provided a method for use in Synchronous Digital Hierarchy (SDH) based communications network comprising a plurality of Intermediate Systems (IS), the IS being divided between at least one IS-IS Area and at least one non-IS-IS Area, wherein when a message is returned from the non-IS-IS Area to the originating IS-IS Area a second choice connection to the destination IS is made.

[0009] The invention will now be described by way of example, with reference to the accompanying drawings, in which;

Figure 1 is a routing diagram illustrating the invention; and

Figure 2 illustrates the ISO 10589 Level 1 and Level 2 IS-IS routing protocols.

## [0010] References:

- [1] ISO/IEC 10589 : 1992 (E) Information technology - Telecommunications and information exchange between systems - Intermediate systems to Intermediate system intra-domain routing information exchange for use in conjunction with the protocol for providing the connectionless-mode Network Service (ISO 8473).

## [0011] Glossary:

Area - An IS-IS Level routing subdomain  
 ES - End System - These systems deliver NPDUs to other systems and receive NPDUs from other systems, but do not relay NPDUs  
*External RAP Route* A RAP Route derived from a RAP with metric type *External*  
*Internal RAP Route* A RAP Route derived from a RAP with a metric type *Internal*  
 IS - Intermediate System (a node where data may be routed on to another IS or to an End System (ES))  
 IS-IS - The IS to IS intra-domain routing protocol as specified in ISO 10589.  
 NE - Network Element  
 NPDU - Network Layer Protocol Data Unit  
 NSAP - Network Service Access Point  
 OSI - Open Systems Interconnection  
 RAP - Reachable Address Prefix  
*RAP Route* Route derived from a RAP (regardless of whether the RAP is configured locally or on a remote Router)  
 Router An IS running IS-IS

- [0012] *Level 1 Intermediate Systems* deliver and receive NPDUs from other systems, and relay NPDUs from other source systems to other designation systems. They route directly to systems within their own areas.

ea, and route towards a Level 2 Intermediate system when the destination system is in a different area.

[0013] *Level 2 Intermediate Systems* act as Level 1 Intermediate systems in addition to acting as a system in the subdomain consisting of Level 2 ISs. Systems in the Level 2 subdomain route towards a destination area, or another routing domain. References to the routing of NPDUs are made with regard to NPDUs destined for NSAPs residing on NEs in the non-IS-IS subdomain.

[0014] References to routing over *RAP Routes* (whether *Internal* or *External*) pertain to routing NPDUs, where the Address Prefix associated with the *RAP Route* is a prefix of the destination NSAP of the NPDUs.

[0015] Knowledge of reference ISO 10589 is assumed and reference is made to terms defined in it. The *RAP Alternate Routing* is an extension to IS-IS and resolves a problem when interworking with non-IS-IS. Although the present invention was born out of an IS-IS problem, it may have applications in other dynamic routing protocols which use and discriminate between static route entries when interworking with other routing protocols, whether dynamic, static or quasi-static.

[0016] IS-IS is a dynamic, link state based, routing protocol which can be included as part of the Network Layer (layer 3) of the OSI Reference Model. For the purpose of this document, ISs running IS-IS will be termed *Routers*.

[0017] *Routers* can participate in two levels or routing:

- i) Level 1 - For routing within an *Area*
- ii) Level 2 - For routing between *Areas*

[0018] *Level 2 Routers* provide the ability to enter static routes to NEs (and subdomains of NEs) which do not support IS-IS. These static routes are termed *Reachable Address Prefixes (RAP)* and they can have a metric type of either *Internal* or *External*. A level 2 *Router*, with a configured RAP, propagates the details of the RAP within its Level 2 link state information. Thus all Level 2 *Routers* gain information about all RAPs configured with the Level 2 subdomain and calculate routes (*RAP Routes*) accordingly. When routing decisions are made, *Internal RAP Routes* are selected in preference to *External RAP Routes*.

[0019] Since the NEs within the non-IS-IS subdomain do not propagate ISO 10589 link state information, the *Routers* cannot determine the state of routes beyond the boundary of the IS-IS subdomain. This means there is no way to monitor complete end-to-end routes which terminate in, or are routed through, the non-IS-IS subdomain.

[0020] There are two problems with this situation:

- i) The inability to provide a second (back-up) route for resilience;
- ii) The possibility of forming routing loops when certain links in the non-IS-IS subdomain break (i.e.

a *Router* may route NPDUs into the non-IS-IS subdomain and the non-IS-IS NEs may route the NPDUs back into the IS-IS subdomain).

[0021] *RAP Alternate Routing* provides resilience when RAPs are used in a mixed routing environment (i.e. to provide routes into non-IS-IS subdomains) by enabling automatic control of a second choice static route to non-IS-IS equipment. This makes use of the two different metric types possible with RAPs (*Internal* and *External*) and will require one of each to be configured within the IS-IS subdomain.

[0022] The two problems i) and ii) above can be solved by selecting *External RAP Routes* when an NPDUs is received on an *Internal RAP Route* and the originally selected outgoing route is an *Internal RAP Route*. By performing this function, *Internal RAP Routes* can be viewed as *primary RAP Routes* and *External RAP Routes* as *secondary RAP Routes*. Provision of this secondary route can provide resilience and can avoid routing loops if the RAPs are configured correctly. A more detailed explanation is given below.

[0023] When a message (NPDUs) is received on a circuit C associated with an *Internal RAP Route* and the selected outgoing route is an *Internal RAP Route*, the Routing Table is searched for another *RAP Route* (i.e. a *RAP Route* other than the *Internal RAP Route* associated with circuit C). The two *Internal RAP Routes* can be different if the IS-IS parameter *maximum Path Splits* is set to 2. *External RAP Routes* are selected in preference to *Internal RAP Routes*. If no other *RAP Route* exists then the original *RAP Route* is selected (an NPDUs forwarded on this route will probably loop and timeout in the network). The message is then forwarded on the circuit associated with the selected route.

[0024] This mechanism provides alternate routing on a packet-by-packet basis. It does not change the state of the RAPs and hence does not advertise the fact that an alternate route has been used to the rest of the network. As soon as the non-IS-IS subdomain is repaired (i.e. it does not route NPDUs back into the IS-IS subdomain), the *RAP Alternate Routing* will cease to be invoked, so the best available route will always be used.

[0025] As an example, referring to Figure 1, an NPDUs from node 1 and destined for node 7 will be routed to node 2, on to node 3 and on to node 4 (since 3 has an *Internal RAP* to the non-IS-IS Routing Domain).

[0026] It is necessary to make assumptions about the routing in the non-IS-IS domain. It is assumed that node 4 will route the NPDUs to node 5 and that node 5 has no choice (because the link between nodes 5 and 7 is broken) and so routes the NPDUs back to node 4. Also assume that node 4, now realising that a route to node 7 via node 5 does not exist, routes the NPDUs back to node 3.

[0027] The actual mechanism of the routing within the non-IS-IS domain is not significant, the key to invoking

ing the *RAP Alternate Routeing* is that an NPDU, destined for the non-IS-IS domain, returns to the IS-IS domain on a link, where a RAP to the non-IS-IS domain is configured.

[0028] The original IS-IS protocol will force node 3 to route the NPDU back into the non-IS-IS domain via node 4. At this point a probable routeing loop has occurred and the NPDU will expire (due to lifetime decay) within the network.

[0029] With *RAP Alternate Routeing* node 3 will detect that it is receiving a NPDU on a link which it should use to route the packet. It will detect that this link is an *Internal RAP Route* for the non-IS-IS domain and will invoke *RAP Alternate Routeing*. Node 3 will then route the NPDU to node 2 (i.e. on the *External RAP Route*).

[0030] Node 2 will receive the NPDU on an *Internal RAP Route* and will route the NPDU to 6 (i.e. on the *External RAP Route*).

[0031] Node 6 will receive the NPDU on an *Internal RAP Route* and will route the NPDU to 7 (i.e. on the *External RAP Route*).

[0032] Node 7 is the destination for the NPDU. Thus the routeing loop described above has been avoided and the NPDU has reached it's destination.

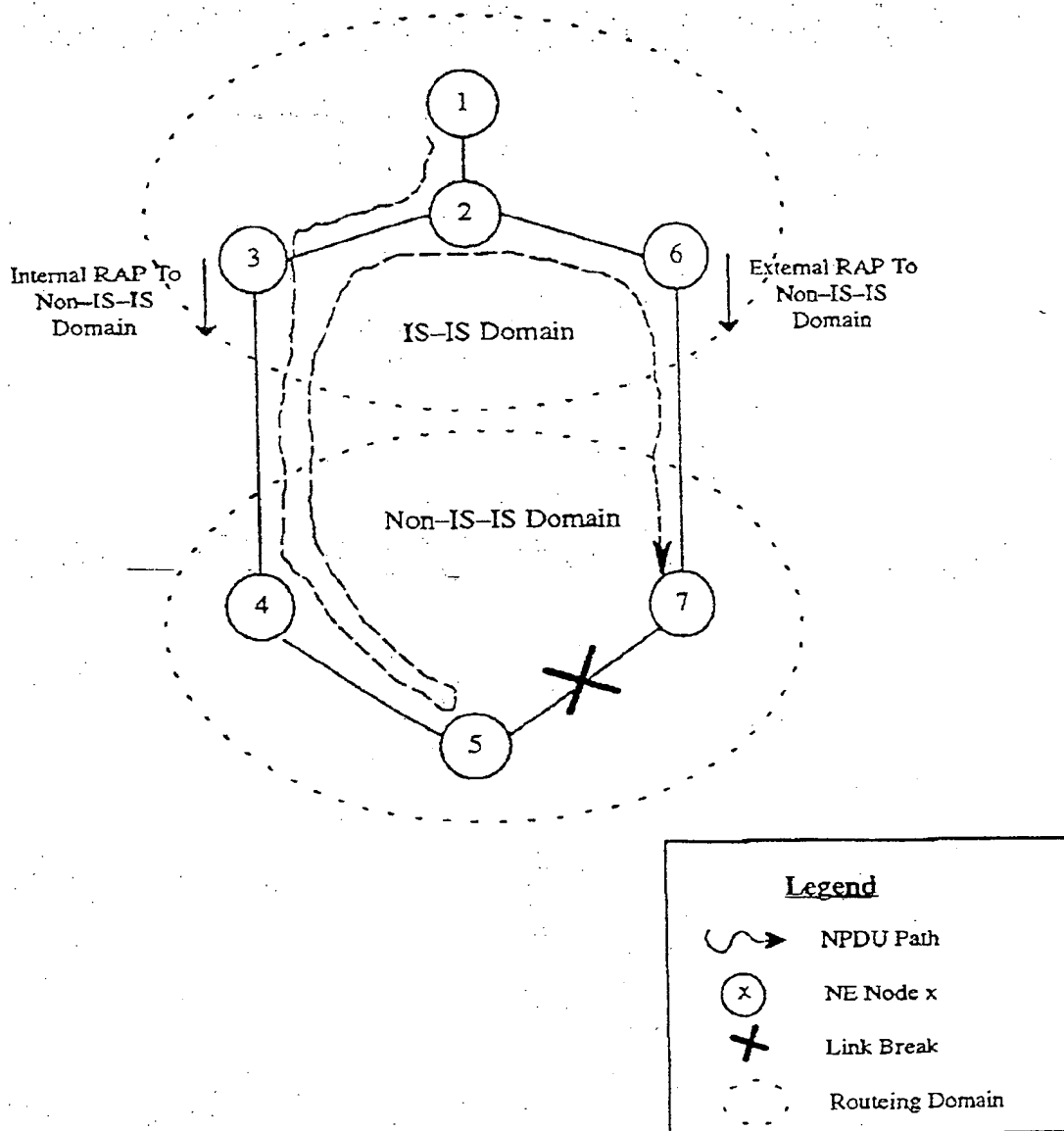
IS-IS Area to the originating IS-IS Area a second choice connection to the destination to the destination IS is made.

4. A method as claimed in Claim 3, wherein where the message is received by the IS-IS Area from the non-IS-IS Area by an Internal RAP Route having been sent to the non-IS-IS Area by an Internal RAP Route, the second choice connection is by an External RAP Route.

## Claims

1. In a Synchronous Digital Hierarchy (SDH) based communications network comprising a plurality of Intermediate Systems (IS), the IS being divided between at least one IS-IS Area and at least one non-IS-IS Area, an IS-IS Area being an area with which a routeing protocol forming part of the Network Layer (Layer 3) of the Open Systems Interconnection, including routeing (OSI), is provided for routeing messages between areas, including routeing means, whereby where a message is routed from an IS-IS Area to a destination IS within a non-IS-IS Area and the connection to the destination IS is broken, and as a result a message is returned from the non-IS-IS Area to the originating IS-IS Area connection to the destination IS is made by a second choice connection.
2. In an SDH network as claimed in Claim 1, the means being arranged so that where the message is received by the IS-IS Area from the non-IS Area by an Internal Reachable Address Prefix (RAP) Route having been sent to the non-IS-IS Area by an Internal RAP Route, the second choice connection is by an External RAP Route.
3. A method for use in a Synchronous Digital Hierarchy (SDH) based communications network comprising a plurality of Intermediate Systems (IS), the IS being divided between at least one IS-IS Area wherein when a message is returned from the non-

Figure 1.



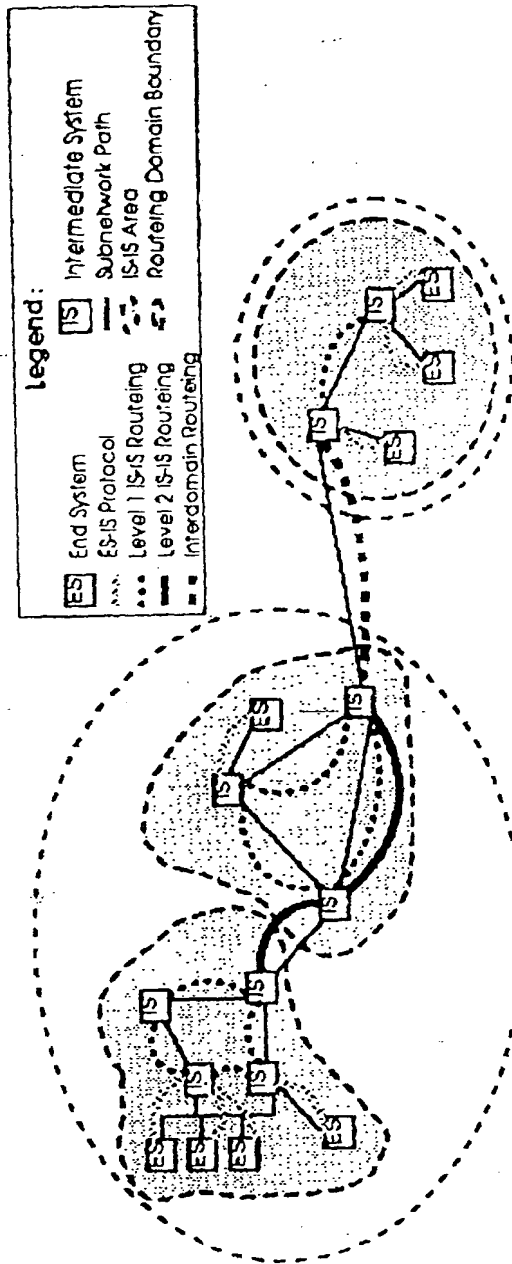


Figure 2



(12)

**EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:  
25.09.2002 Bulletin 2002/39

(51) Int Cl.7: **H04L 12/56**, H04Q 3/00,  
H04J 3/16

(43) Date of publication A2:  
03.02.1999 Bulletin 1999/05

(21) Application number: 98301856.5

(22) Date of filing: 12.03.1998

(84) Designated Contracting States:  
**AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC  
 NL PT SE**  
 Designated Extension States:  
**AL LT LV MK RO SI**

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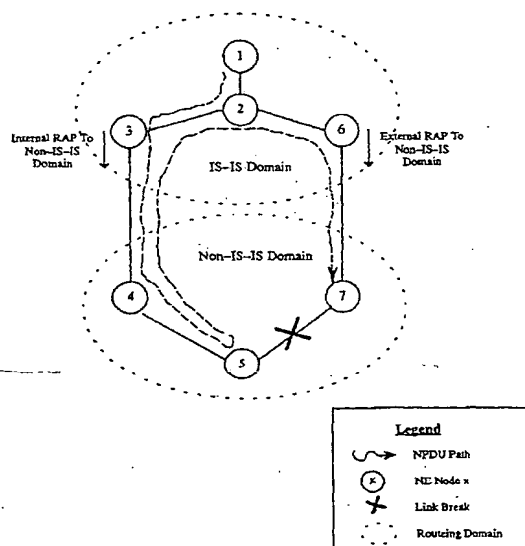
(30) Priority: 31.07.1997 GB 9716198

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(54) Reachable Address Prefix alternative routing for iso 10589

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**Figure 1.**



**EP 0 895 380 A3**



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# EUROPEAN SEARCH REPORT

Application Number  
EP 98 30 1856

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	AMBROSOLI L ET AL: "TMN architecture for SDH networks using IS-IS routing protocol: design and performances" PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON COMMUNICATION TECHNOLOGY, vol. 1, 5 May 1996 (1996-05-05), pages 223-227, XP002159253 * Abstract * * Paragraph 3.2 *	1-4	H04L12/56 H04Q3/00 H04J3/16
A	ISO: "Information technology - Telecommunications and information systems - Intermediate system to Intermediate system intra-domain routing information exchange protocol for use in conjunction with the protocol for providing the connectionless-mode Network Service (ISO 8473)" INTERNATIONAL STANDARD - ISO/IEC 10589, 30 April 1992 (1992-04-30), XP002207036 * page 5 - page 35 *	1-4	
A	KATZ H ET AL: "SDH management network: architecture, routing and addressing" GLOBAL TELECOMMUNICATIONS CONFERENCE, 1993, INCLUDING A COMMUNICATIONS THEORY MINI-CONFERENCE. TECHNICAL PROGRAM CONFERENCE RECORD, IEEE IN HOUSTON. GLOBECOM '93., IEEE HOUSTON, TX, USA, IEEE, 29 November 1993 (1993-11-29), pages 223-228, XP010109709 ISBN: 0-7803-0917-0 * page 223, right-hand column, line 28 - line 43 * * page 226, right-hand column, line 1 - line 41 *	1-4	H04J
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 26 July 2002	Examiner Belloni, P
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03.92 (P4/C01)





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# EUROPEAN SEARCH REPORT

Application Number  
EP 98 30 1856

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US 5 430 727 A (CALLON ROSS W ET AL) 4 July 1995 (1995-07-04) * column 4, line 60 - line 68 * * column 5, line 1 - line 14 * * column 8, line 54 - line 62 * * column 9, line 48 - line 58 * * column 43, line 67 - line 68 * * column 44, line 1 - line 8 * * claims 1-4 *	1-4	
A	US 5 262 906 A (MAZZOLA ANTHONY J) 16 November 1993 (1993-11-16) * column 4, line 30 - line 62 * * column 6, line 9 - line 15 * * claim 1 *	1-4	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
The present search report has been drawn up for all claims			
Place of search MUNICH		Date of completion of the search 26 July 2002	Examiner Belloni, P
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

EPO FORM 1503 03 82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.

EP 98 30 1856

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26-07-2002

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 5430727	A	04-07-1995	US 5251205 A	05-10-1993
			US 5557745 A	17-09-1996
US 5262906	A	16-11-1993	CA 2092872 A1	20-12-1993

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NO MARGINALIA

EPO FORM H0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82